Risk perception survey in two high-risk areas

Guido Signorino, Elise Beck

15. RISK PERCEPTION SURVEY IN TWO HIGH-RISK AREAS

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Introduction

This chapter presents the main results of a survey on risk. The survey used a questionnaire (see the section on "Questionnaire: multipurpose investigation on a population in an area at risk" in the Annex) on a representative sample of 1200 people living in the petrochemical areas of Augusta–Priolo (n = 700) and Milazzo–Valle del Mela (n = 500). The aim of the survey was to increase comprehension of the risk perception characteristics of the local populations and of their socioeconomic determinants – a topic crucial to defining appropriate communication strategies and to elaborating and supporting land remediation policies based on bottom-up methodologies and public health plans for preventing illness.

The Spatial Perception of Risk, Health, Environment, and its Communication (PRITASC) survey provided a comparison of the risk perception profiles of the two populations and studied the association between risk perception and many social and economic characteristics of populations, finding that gender, working conditions, being parents (and especially mothers), age, and education affect risk perception patterns. The research results show that the two populations have different perceptions of diverse risks, except those more strictly associated with the presence of industrial plants – that is, risks that relate to health, the environment and industrial hazards, for which the survey showed identical risk perception profiles.

By combining socioeconomic information and geographic methods, the survey also investigated the localization of people and their mobility and spatial perception of risk, applying the *logbook* and *mental map* methods (see the subsection on "Mental map methods in this chapter), to elucidate both the pressures of human origin on the territory and the perception of risk by local populations. The logbook consisted of a table in which the respondents indicated their daily displacements, step by step (see Chapter 12 for further details about this method).

This chapter is structured as follows:

- a theoretical introduction to risk perception and risk communication
- the methods and main findings of the research
- the mental-map approach to characterizing people's territorial representation of risk
- the result of the application of the mental-map approach.

Risk perception and communication: the PRITASC model

Risk perception, risk communication, and behaviour

The effectiveness of risk reduction strategies in risk contexts is influenced considerably by human behaviour which, in turn, is related to risk perception. Grothman & Reusswog (2006), after stressing that self-protective behaviour by residents may reduce the monetary damage of floods by 80%, observed that private precautionary damage prevention and mitigation by residents is determined by people's risk perception and awareness (see also Botzen, Aerts & van den Bergh, 2009). Similarly, the perception of risks related to personal health affects people's desire for access to medical services (Atkinson & Facanha Farias, 1995), and the perception of risks related to food influences its consumption (Dosman, Adamowicz & Hrudey, 2001; Lobb, Mazzocchi & Traill, 2007). On the other hand, risk (and, more specifically, risk perception) can be interpreted as a combination of objective factors (such as exposure levels) and subjective evaluations derived from a person's education, culture, values and beliefs.

Klinke & Renn (2002:1076) stated, "There is no doubt that the term 'risk' refers to the experience of something that people fear or regard as negative. … Since risk refers to a potential of 'real' consequences … it is both a social construction and a representation of reality." It follows that, to assess risk, a "dual strategy" that includes both physical elements (technically and scientifically defined and measured) and sociopsychological criteria should be initiated. These "should be treated as criteria in their own right and not be regarded as modifiers of the physical consequences."

Furthermore, as already mentioned, a respondent's risk perception is affected substantially by such economic, social and cultural variables as gender, number of children in their family and their education (Flynn, Slovic & Mertz, 1994; Konè & Mullet, 1994; Dosman, Adamowicz & Hrudey, 2001) and by the quality of information about health and territorial conditions (Wallquist, Visschers & Siegrist, 2010).

Given the complex relationship that exists among perception, behaviour, and socioeconomic characteristics of local populations, discussions of the field of risk perception and communication are increasing – with associated interactions (both from methodological and operative perspectives) – among social scientists, epidemiologists, environmental scholars and policy-makers, especially when remediation plans and risk management strategies need to be defined. In line with increasing dialogues about risk, risk communication has gained increasing importance in the design and definition of the goals and policy instruments of environmental epidemiology, including the creation of guidelines, recommendations and definitions of goals for territorial governance. Also, risk communication is increasingly considered to be an instrument for protecting public health (Ropeik & Slovic, 2006).

As a consequence of increasing interest, the assessment of risk perception should be considered a fundamental instrument for creating proper risk communication plans that sustain the implementation of risk-management and territorial-remediation strategies.

Imperatives and models of risk communication

According to its ends (goals) or to its ethical content, risk communication responds to three alternative imperatives (that is, influences or factors that make it necessary): normative, instrumental and substantial (Wardman, 2008).

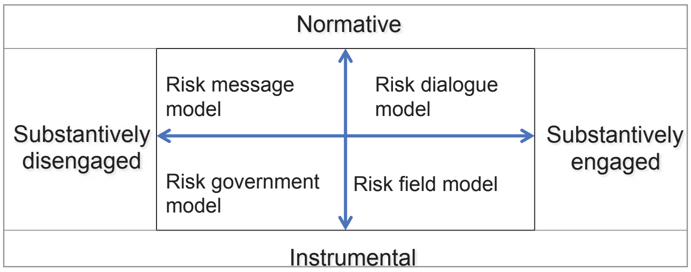
The *normative* imperative considers risk communication to be an end in itself, suggesting that, in a democratic society, risk communication is essentially an expression of a general *right to be informed*, to make correct and optimal choices. This gives rise to: (a) a parallel obligation to fully and correctly inform the public about risks that concern human behaviour or (b) specific activities for governments, business organizations, or even individual agents. The common procedure of informed consent is an example of the normative imperative of risk communication.

The *instrumental* imperative treats risk communication as a *means* of helping organizations or interest groups reach strategic objectives (such as survival or adaptation) when interacting with a potentially (or actually) hostile social setting. Examples of this kind of communication follow specific accidents or crises, such as Chernobyl (Wynne, 1989, 1992), the so-called mad cow disease crisis (Leiss, 1996), the Brent Spar oil platform dumping in the North Sea (Löfstedt & Renn, 1997) and the Bophal disaster (Chess, 2001). Instrumental communication is also used extensively by environmental organizations, such as Greenpeace, to support specific campaigns (Bakir, 2005; Wardman, 2008).

Finally, the *substantial* imperative orients communication towards change, and its goal is to improve government strategies or people's behaviour in risk scenarios. This approach could be interpreted as *instrumental*, if it is related to the objective of realizing an informative framework aimed at supporting the choices made by governments. However, to the extent that it pursues the general interest, rather than particular private interests, it differs from instrumental communication in its goals and tools.

By making different combinations of the normative or instrumental goals and the level of *substantial engagement* of social actors, Wardman (2008) provides a general framework for outlining four conceptual models of risk communication, which is expressed in the following scheme (Fig. 51).

Fig. 51. Four conceptual models of risk communication



Source: Wardman (2008:1623).

According to Wardman (2008:1623),

> The vertical axis [of Fig. 51] conveys the implied communicative intent of [the] driver of risk communication (i.e. normative or instrumental), whereas the horizontal axis characterizes the co-involvement of different agents in the social construction of risk (i.e. how potential participants are seen to be substantively engaged in constituting communicative action and risk meaning).

The upper left-hand corner of Fig. 51 combines the normative imperative with substantial disengagement of stakeholders and social actors, producing the *risk message model* of risk communication. This model provides a unidirectional approach to risk communication, where emphasis is placed on institutions' and policy-makers' *duty to inform*. In this approach, experts play the primary role within a communication strategy, focusing on the content and comprehensiveness of the message, while the target population plays a passive, receptive role. In many cases, this traditional top-down approach – which does not imply any interactive involvement for groups receiving information – revealed itself to be unable to generate either changes or awareness in the communities targeted (Sturloni, 2003), especially when the communication strategy did not take into account such factors as the cultural background, the economic and social variables, and the moral values of these communities.

The *risk dialogue model*, which combines the normative imperative with substantial engagement of social actors, takes a different and more participatory approach to risk communication and views it as the right to be informed. This model of communication attempts to outline rules and methods for the creation of forums that aim to share knowledge on the existing conditions of risk (Pellizzoni, 2010) and to define shared strategies for ruling the territories. The risk dialogue model is apt to process and communicate information on environmental and sanitary risks in contexts characterized by general or specific risks – that is, risks the address either entire areas or specific groups. Some experiences, however, show that the involvement of communities in the decision-making process that relates to the management of risk contexts presents several problems.

The first problem involves the difficulties related to the popular understanding of science, which occurs when populations require and expect ultimate answers that experts cannot provide. The *paradigm of uncertainty* causes a lack of trust in *technicians*, which may stop and worsen (rather than enhance) public awareness. The second problem is that of public involvement potentially generating an *excess of demand* – that is, a number of claims (either general or particular) that cannot be satisfied by policy-makers, so generating frustration and discontent within populations. The third problem, involves the cost of participation: attending meetings and forums implies a sacrifice of time and (sometime) money, so those who participate are particularly motivated to do so. As a consequence, meetings organized to hear public opinion are often biased and the participants self-selected (Campbell & Townsend, 2003). Finally, it is possible that the particular interests of participants generate conflicts that cannot be resolved (Pellizzoni, 2010), producing conditions of indeterminacy, in line with Arrow's impossibility theorem.[25]

Directly linked to the instrumental imperative – and reflecting a potential contrast between the different stakeholders just mentioned – the *risk field model* (on the lower right-hand side of Fig. 51) regards risk communication as a strategic tool used by competing social actors (such as business firms and environmental associations). These actors use risk communication to influence public opinion and policy-makers' decisions about specific *fields* (such as nuclear plants, vaccination campaigns and social reforms) that can create hazards for the socioeconomic or environmental habits of society or for public health. Such conflicting aims and the biased distribution of risks (or hazards) – which can occur when public audits are established to plan land use – may lead to impasses to a unified social representation of risk (Boholm, 2008); in the risk field model, however, public awareness may increase, due to information that competing actors provide to mobilize public opinion or political power.

The last of the models in Fig. 51, the *risk government model*, suggests that risk communication should have an educational content, thus stimulating behavioural population responses that reduce social risk, under the assumption that persuasion is more effective than prohibition (Fischhoff, 2005)., The purpose of this model of risk communication is to involve local populations, providing them with full responsibility for risk-reduction strategies. However, within this framework, people actually play a passive role within the communicative strategy, with the public viewed as a mere *receptor* of information aimed at coping with hazardous situations. Under a Foucaultian perspective, the risk government model can be viewed as an exercise in power relations, where political actors use the media to transfer the responsibility of risk prevention to citizens, through various forms of self-restricting behaviour (Rose, 1999; Wardman, 2008). For example, people may be independently driven to stay at home during days of peak pollution; in this way, prevention strategies are privatized and no specific responsibility is assumed by policy actors or by polluting firms.

Clearly, the risk government model of risk communication attributes great importance to knowledge of risk perception, as persuasion requires deep insight into human psychology. In line with such persuasion, social scientists may be manipulated to reach political ends within a biased context (Fischhoff, 1990). According to this perspective, Wardman (2008:1634) warns that:

> … social science can quite feasibly be put to work against the public interest on occasions when:
>
> 1. Political aspersions, which cast the public as troublesome, are simply and uncritically accepted by academics, thus undermining the public's political credibility.
> 2. Social scientific remedies prescribed to deal with such behaviour shift the political balance against the public interest.
> 3. Claiming to know how [to] explain their behaviour reduced the perceived need to let different publics speak for themselves.
> 4. Assisting policymakers leads to the fortification of their power, by helping them fine tune programmes, anticipate and overcome resistance, or guide and legitimize initiatives.
> 5. Claiming to know what particular publics might want and need without seeking their clarification is used to justify current actions.
> 6. Research findings are misappropriated by policymakers to justify decisions that actually disadvantage and disenfranchise the people concerned.

The PRITASC risk communication model

Given the theoretical framework outlined above, the PRITASC survey, within a normative–substantial perspective, adopted an original combination of risk dialogue and risk government approaches that can be defined as the *participative risk management model*. The intent of this approach is to increase the qual-

25 Economist Kenneth Arrow's theorem states that, when voters have three or more distinct alternatives, no voting system can be designed that converts their ranked preferences into a broad ranking while also satisfying a set of criteria of fairness.

ity of the information available to policy-makers and – at the same time – to raise the awareness of the populations, thus improving their ability to interact with institutions, within the definition of effective public health improvement strategies. The role of so-called experts is then twofold: to provide a scientific base for political decisions and to correctly (and in an understandable way) inform populations about the actual risk context. In the general context of the public being concerned, due to uncertainty and lack of information, risk perception has been analysed deeply to find the proper communication mode, aiming to transfer knowledge not only to policy-makers, but also to the public.

Within the communication plan, two specific instruments were established to enhance public participation and sharing: (a) the initial results of the survey were discussed within *restitution (or feedback) focus groups*,[26] where researchers met with groups of citizens to verify their general acceptance of the conclusions of the research; and (b) after having reported scientific evidence to the Sicilian Council, local assemblies were asked to disseminate and publicly discuss information with the populations studied, stakeholders and political administrators.

The PRITASC survey: methodological issues

A total of about 265 000 people live in the areas of Milazzo–Valle del Mela (55 504 inhabitants) and Augusta–Priolo (209 352 inhabitants), which the Italian and Sicilian governments have declared to be at high risk of environmental contamination. Within a broader project of scientific assistance to the regional administration, from December 2007 to June 2008, a survey of risk perception was conducted on a representative sample of 1200 people living in the petrochemical areas of Augusta–Priolo ($n = 700$) and Milazzo–Valle del Mela ($n = 500$), to compare risk perception patterns between the two populations.

The questionnaire and the samples

Under the scrutiny of an international committee, a specific questionnaire was developed and administered person to person. The questionnaire was composed of six sections, which aimed to investigate: (a) the characteristics of individuals; (b) daily mobility habits and home and/or work locations; (c) risk perception; (d) the characteristics of the home; (e) family socioeconomic information; and (f) living standard (see the Annex).

The section on daily mobility required the interviewees to indicate on a map the locations of their home and school and/or work; it also required them to report their individual movements in the time frame of 00:00–24:00 hours of the previous day, within 15-minute intervals. The section on risk perception progressed from general and social risk perception to risk conceptualization and territorial risk and personal exposure evaluation. These two sections were quite complex and two different versions of the questionnaire were edited: in the second version, the mobility section was positioned after risk perception and home characteristics.

Before being administered, the questionnaire was tested in 20 cognitive interviews and a series of focus groups held in Milazzo, testing both its wording and comprehensibility (Gatto, Mudu & Saitta, 2008; Gatto et al., 2009). In line with the participative approach of the PRITASC model, a second series of focus groups were carried out in Augusta, to test the preliminary results of the survey, so starting a restitution (feedback) process aimed at discussing and democratizing the survey's interpretation.

Samples of the two populations were selected from the electoral registers and stratified according to the demographic size of the municipalities. The sampling error was estimated to be lower than 5%, both in the Augusta–Priolo and Milazzo–Valle del Mela areas.

26 Restitution (feedback) – originally understood as an exchange between the researcher and the groups observed, which consists of delivering the results of a study to the groups targeted for their internal use – has gradually come to indicate the involvement of the subjects studied in the research, to assess their agreement with the opinions that result from the study (Whyte, 1983). The origin of this trend is the growing awareness of the political importance of any scientific description.

Risk perception index and risk perception profiles

From a list of 15 so-called social risks (road accidents, food risks, drug addiction, deterioration of the environment, war, poverty and social exclusion, natural disasters, terrorism, unemployment, serious illnesses, nuclear threats, industrial disasters, insecurity and uncertainty, extremely low-frequency electromagnetic fields, and extremely high-frequency electromagnetic fields), respondents were asked to express their degree of preoccupation on a Likert-type scale, which assumes the intensity of feeling about a topic is linear; in this case, they were asked to respond to four choices: most worried, very worried, moderately worried and no worry. From their answers, a synthetic *risk perception index* and an analytical *risk perception profile* were estimated within the two samples and used to compare territorial differences and similarities (Signorino, 2012).

The risk perception index (RPI), ranging from 0 (no worry) to 1 (top worry), is calculated as a weighted average of absolute frequencies of each choice:

$$RPI = (\textstyle\sum_i n_i \cdot \pi_i)/\mathrm{N} \cdot 3,$$

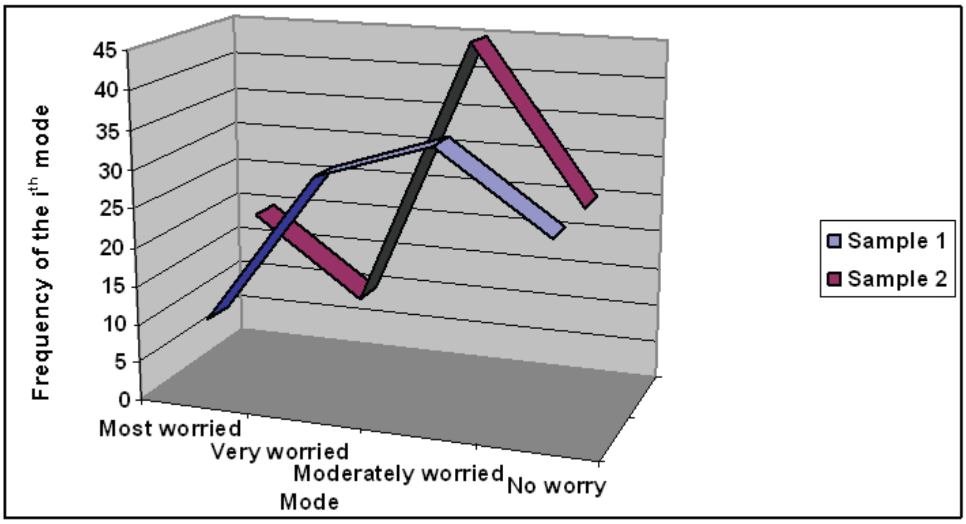
where: n_i represents the absolute frequency of the ith mode; π_i represents the weight assigned to the ith mode (that is, most worried = 3; very worried = 2; moderately worried = 1; and no worry/doesn't know = 0); and N represents the total number of observations.

In its present use, the expression *risk profile* means the way in which risk perception is distributed among different modes within the populations. As RPI is a weighted average of $n = 4$ modes, it is possible that identical values reflect different distributions of the modes among respondents belonging to distinct samples. For example, suppose two samples, each with 100 subjects, revealed the following distribution of modes in a risk perception survey:

- Sample 1: most worried = 10; very worried = 30; moderately worried = 35; no worry = 25; and
- Sample 2: most worried = 20; very worried =10; moderately worried = 45; no worry = 25.

The RPI would be the same in the two populations ($\mathrm{RPI}_1 = \mathrm{RPI}_2 = 0.4167$), but the distribution of frequency among the modes is very different, as Fig. 52 clearly shows.

Fig. 52. Hypothetical profiles of risk perception for identical RPIs



In particular, in spite of almost identical *synthetic* risk perception indexes, Sample 1 shows a higher proportion of both "most worried" and "moderately worried" people, and a lower proportion of "very worried" people, so expressing a different risk perception profile than Sample 2. To evaluate differences in risk perception profiles between the two samples, a χ^2 test for the equivalence of relative frequencies was implemented.

Mental map method

Besides considering the socioeconomic characteristics of risk perception, a map of the area was also integrated into the survey, to evaluate the spatial representation of risk, which is one component of risk perception (or the cognitive representation of risk). On a simplified map of the area studied; the questionnaire respondent was asked to draw the area he or she considered at risk.

Few studies of risk perception use mental maps – that is, interviewees are asked to draw a sketch map of an area or draw, as in our case, one or more areas, or points or streets that are associated with risk areas – to take into account the spatial dimension. Most use questionnaires (Duchene & Morel-Journel, 2004) that are processed through multivariate analysis to define social profiles (Guéguen et al., 2009) or, when these data are compiled to identify vulnerable areas or groups, use synthetic indexes (D'Ercole, 1996; Cutter, Mitchell & Scott, 2000; Glatron & Beck, 2008).

The spatial dimension can also be integrated into these surveys, as a tool that represents data: being the respondents are georeferenced, their answers can be mapped (Bonnet, 2002; Beck, 2006), and the spatial dimension can be taken into account as an explanatory variable of the variations of risk perception, especially when the question of distance to the source of risk is addressed (D'Ercole, 1996; Peacock, Brody & Highfield, 2005; Howe, 2010).

Mental maps (or sketch maps) have been used mainly in the study of the cognitive representation of the environment, especially to understand the variables that influence the mobility of people in cities (Lynch, 1960; Cauvin, 1999).The use of mental maps is not yet widespread in the field of risk (Bonnet, 2002), and sometimes the survey consists of asking respondents to draw the area already affected by a disastrous event (Brilly & Polic, 2005).

Mental maps can be collected through various methods.

- **White sheet.** Respondents are asked to draw their environment (such as district in which they live or city centre) on a blank sheet of paper. They are free to choose the scale, number of elements they represent and so on. Only the size of the white sheet can influence the respondent. The resulting map shows the distortions of the mental construction of space with respect to real space.
- **Simplified or detailed map.** Respondents are asked to locate a specific area that relates to the topic of the survey. The difference between the two methods (simplified or detailed) comes from the amount of information present on the map.
- **Spatial reconstruction game** (Ramadier & Bronner, 2006). In this method, the respondent is asked to build, with wooden pieces and strings, a three-dimensional map of their environment. According to the authors of this method, it is especially adapted to an illiterate population – that is, one with difficulties in drawing. The resulting map also shows the distortions of the respondents' mental construction of space.

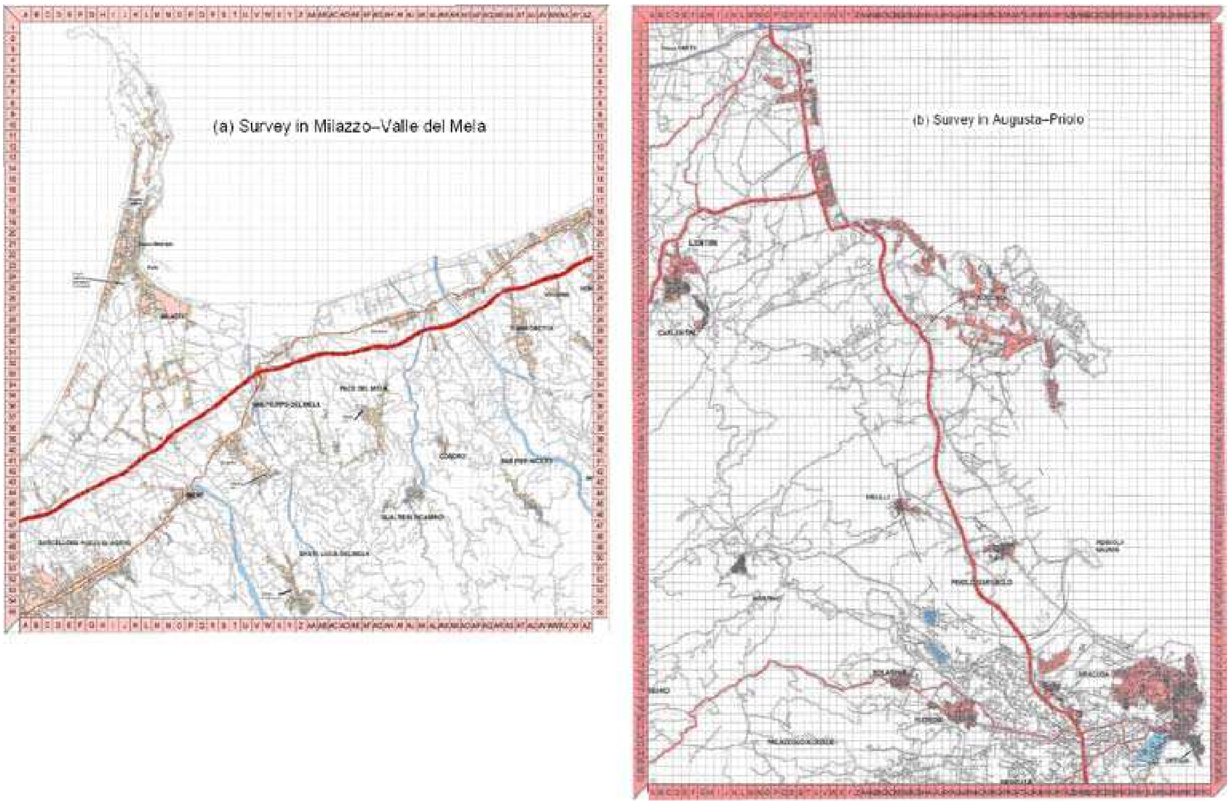
Each method presents disadvantages that need to be carefully considered in applications.

- **White sheets.** The resulting drawings are difficult to process. They can be digitized, but need special tools to tackle anamorphosis – that is, from a distorted projection or perspective find a suitable reprojection to reconstruct an image that appears normal.
- **Simplified map.** This technique implies the need to choose the details that will appear on the map.
- **Detailed map.** The map is not easy to read and is not always understandable.
- **Spatial reconstruction game.** It is difficult to use this method on a large sample for different reasons, such as the equipment and time needed to administer the survey, and the processing of the resulting three-dimensional map.

Among others, Bonnet (Bonnet, 2002; Amalric & Bonnet, 2010) introduced the use of mental maps to the field of risk. The maps were used to integrate the spatial component of the cognitive representation of risk into the mapping of vulnerability to industrial hazards. The preferential use of the simplified map, instead of the white sheet, is suggested for allowing respondents to locate things in space. Even if this method can be criticized (Beck, 2006), it allows easy and fast processing through the use of GIS, as was the case in the PRITASC survey.

In the PRITASC survey, the choice of the details that would appear on the simplified map was not left entirely to the researchers – to minimize subjectivity. In the case of Milazzo–Valle del Mela, 24 adults participated in focus groups, whereas in-depth interviews were carried out in the area of Augusta–Priolo (Gatto, Mudu & Saitta, 2008). The different meetings allowed the definition of what would be represented on the map and which scale would best fit the objective of the survey (see Fig. 53). A grid was overlaid on the maps, to help process the information. In Milazzo–Valle del Mela, the grid-cell size was 250 m; it was 440 m for the case of Augusta–Priolo. The size of the printed maps was a standard A3 paper format.

Fig. 53. Maps used for the survey in Milazzo–Valle del Mela and Augusta–Priolo



Note. Red lines indicate main roads; reddish areas indicate main urban areas.

In the Milazzo–Valle del Mela area, 484 respondents provided a mental map, and 646 respondents provided them in the Augusta–Priolo area. In Fig. 54, the Milazzo–Valle del Mela chart shows an example of a sketched map. Each polygon drawn by respondents, representing an area at risk, was digitized and superimposed on the map (see Fig. 54).

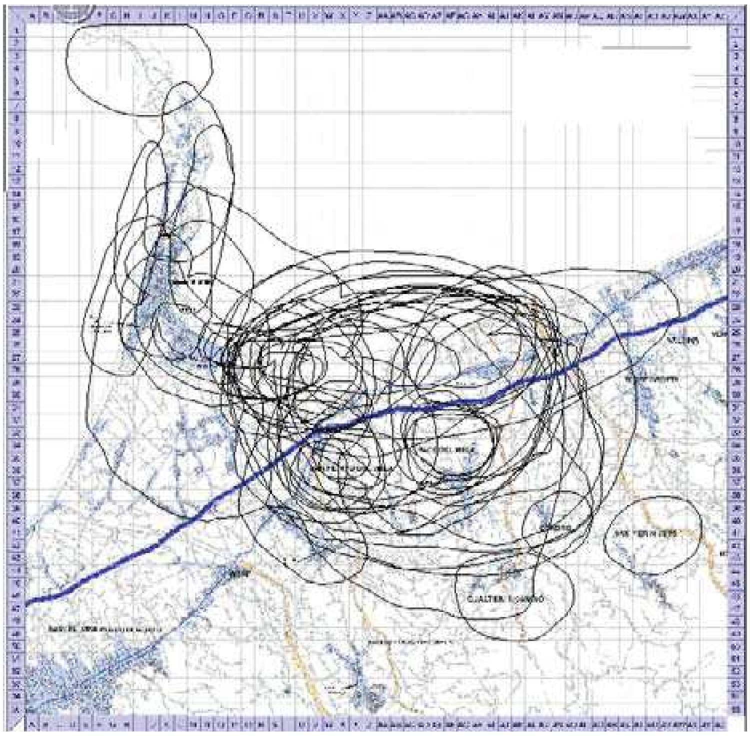
Following Bonnet's method (Bonnet, 2002), a grid (with the same resolution as indicated previously) was overlaid on the digitized polygons. For each cell, a spatial join (which associates attributes from one data layer – a single set of files in GIS – with the objects in another layer) allowed the number of overlapping polygons to be counted, to identify which areas the respondents considered to be at greatest risk. The resulting synthetic map was then compared to the limits of the so-called official area at risk, to identify the distortion of the perceived risk from the so-called real risk, as indicated in the official definition of site of national concern.

In addition to sociodemographic factors, such as age and gender, the following factors also influence an individual's cognitive representations of spatial risk.

- The experience of space or an environment influences the capacity to describe the risk related to it, so that living or travelling in the same environment every day helps to provide a better understanding of it (Lynch, 1960; Cauvin, 1999).

- Knowledge of the spatial extent of a risk, which is often not communicated and thus poorly integrated by the population (Beck & Glatron, 2008), is another factor. Since the spatial extent of a risk is complex (usually different from other risks, such as earthquakes and floods, for the industrial boundaries of a hazardous site), the population identifies the risk less easily. This is especially true when different spatial extensions are communicated by local authorities, which is often the case. This results in a mismatch between the spatial extent of perceived risk and the spatial extent of official risk.

Fig. 54. Example of digitized polygons for the Milazzo–Valle del Mela area



PRITASC survey results for the two areas studied

Table 93 shows that, on average, risk perception seems to be quite high (RPI greater than 0.5 for all risks, except extremely low-frequency electromagnetic fields in the Augusta–Priolo area). Also, despite some differences in ranking, average risk perception is very similar within the two areas. The four most perceived risks, showing RPI > 0.75, are the same items both in Milazzo-Valle del Mela and in Augusta-Priolo (serious illnesses, environmental degradation, unemployment and industrial disasters). As a result, risk perception is found to be strictly connected with the environmental and socioeconomic sustainability of the local development model (described in Chapter 8).

However, investigating the relative frequencies of the *most worried* option shows it to always be higher in the Milazzo–Valle del Mela area, in relation to all 15 items. This implies that, given the similarity of the average index value, a different distribution of frequencies in the risk perception profile characterizes the two high-risk areas (Signorino, 2012).

To investigate the differences in risk perception profiles between the two populations, a χ^2 test was performed for each risk. The test showed that the null hypothesis – that is, that the relative frequencies are equal between the two populations – is rejected when the estimated χ^2 is higher than its tabular value. Table 94 shows that risk perception profiles are statistically different when considering all risks. An exception, where they are similar, is the three risks (in bold type) that appear to be most related to the territorial impact of industries: environmental degradation, serious illnesses and industrial disasters.

Table 93. RPI in the two areas: a statistical test of independence

Risk		RPI[a]		Percentage of most worried	
		MVM	AP	MVM	AP
1	Road accidents	0.68	0.67	30.6	24.1
2	Food risks	0.59	0.59	23.4	18.5
3	Drug addiction	0.66	0.65	34.0	22.6
4	Deterioration of the environment	0.81	0.79	52.4	46.2
5	War	0.63	0.64	30.9	24.4
6	Poverty and social exclusion	0.68	0.67	34.9	23.6
7	Natural disasters	0.64	0.69	31.9	31.2
8	Terrorism	0.62	0.63	29.3	22.0
9	Unemployment	0.77	0.86	46.2	44.5
10	Serious illnesses	0.82	0.82	56.9	54.6
11	Nuclear threats	0.57	0.55	27.2	17.7
12	Industrial disasters	0.75	0.75	44.7	42.8
13	Insecurity and uncertainty	0.67	0.67	29.5	20.9
14	Extremely low-frequency electromagnetic fields	0.56	0.47	19.5	10.9
15	Extremely high-frequency electromagnetic fields	0.58	0.52	19.6	13.4
	Average	**0.670**	**0.665**	--	--

[a] MVM: the Milazzo–Valle del Mela area; AP: the Augusta–Priolo area.

Table 94. Risk perception: a statistical test of independence of the two populations

Risk		Estimated χ^2 versus a tabular χ^2 = 7.8	Risk perception profile
1	Road accidents	13.2	Different
2	Food risks	10.8	Different
3	Drug addiction	38.8	Different
4	**Deterioration of the environment**	**5.0**	**Similar**
5	War	28.4	Different
6	Poverty and social exclusion	36.7	Different
7	Natural disasters	27.7	Different
8	Terrorism	28.3	Different
9	Unemployment	8.9	Different
10	**Serious illnesses**	**3.4**	**Similar**
11	Nuclear threats	24.0	Different
12	**Industrial disasters**	**5.5**	**Similar**
13	Insecurity and uncertainty	32.3	Different
14	Extremely low-frequency electromagnetic fields	37.9	Different
15	Extremely high-frequency electromagnetic fields	14.7	Different

* Degrees of freedom = 3; $\alpha = 0.05$.

It follows that the features of the local industrial development model (see Chapter 8) assimilate the risk perceptions of health and environmental hazards of populations that have, in general, different risk perception profiles.

Socioeconomic characteristics of risk perception

As already mentioned, in running preliminary focus groups to set the survey's analytical framework, the following hypothesis emerged: specific socioeconomic characteristics of populations (such as gender, education, working conditions, age, and being parents, especially mothers) may influence risk perception.

As environmental, health and industrial risks showed identical perception profiles within the two areas, the two populations were studied to elucidate whether these socioeconomic characteristics influence risk perception. We built contingency tables that relate the four modes of risk perception (most worried, very worried, moderately worried and no worry/doesn't know) to serious illnesses, industrial disasters and environmental degradation and then applied χ^2 tests. Table 95 shows the result of the testing procedure.

High *P* values show that the number of family members does not influence the perception of risk to health and the environment in the two populations, while gender, education, or being parents (especially mothers) significantly differentiate risk perception for health and industrial hazards.

Table 95. Risk perception and the populations' socioeconomic characteristics

Risk	Socioeconomic characteristics						
	Gender	Education	Working conditions	Family members	Age	Parents	Mothers
Serious illnesses	$\chi^2 = 22.9$** df = 2 $P = 0.000$	$\chi^2 = 21.4$** df = 6 $P = 0.002$	$\chi^2 = 30.1$** df = 12 $P = 0.003$	$\chi^2 = 10.7$ df = 4 $P = 0.379$	$\chi^2 = 1.9$ df = 4 $P = 0.758$	$\chi^2 = 11.1$** df = 4 $P = 0.025$	$\chi^2 = 8.8$** df = 2 $P = 0.016$
Industrial disasters	$\chi^2 = 14.6$** df = 2 $P = 0.001$	$\chi^2 = 20.1$** df = 6 $P = 0.003$	$\chi^2 = 14.7$ df = 12 $P = 0.260$	$\chi^2 = 4.3$ df = 6 $P = 0.930$	$\chi^2 = 8.1$* df = 4 $P = 0.088$	$\chi^2 = 10.3$** df = 4 $P = 0.036$	$\chi^2 = 7.7$** df = 2 $P = 0.021$
Deterioration of the environment	$\chi^2 = 3.8$ df = 2 $P = 0.153$	$\chi^2 = 8.2$ df = 6 $P = 0.222$	$\chi^2 = 17.0$ df = 12 $P = 0.151$	$\chi^2 = 10.0$ df = 10 $P = 0.441$	$\chi^2 = 18.6$** df = 4 $P = 0.001$	$\chi^2 = 6.6$ df =4 $P = 0.160$	$\chi^2 = 5.5$* df = 2 $P = 0.064$

df: degrees of freedom.
* Statistically significant at the 95% confidence level.
** Statistically significant at the 90% confidence level.

More specifically, on average, and referring to the three categories of risk indicated in the table, women are more worried than men, less educated people are more anxious than more educated people, and people with children (especially mothers) are more troubled than people without children. Also, working conditions do not influence the perception of industrial hazards, but they do differentiate the perception of health risks: members of the labour force and housewives are more worried about them than students, retired workers and workers without a permanent job. Moreover, age does not influence the perception of health risks, but it does differentiate (at the 90% confidence level) the perception of industrial hazards (adults are more worried than young people and the elderly).

Environmental degradation is intensely perceived by populations, independent of gender, education, working conditions and being a person with a child(ren), while being a mother and, especially, age (adults are more worried than young people and the elderly) differentiate risk perception for this hazard.

The space dimension of risk perception: mental maps

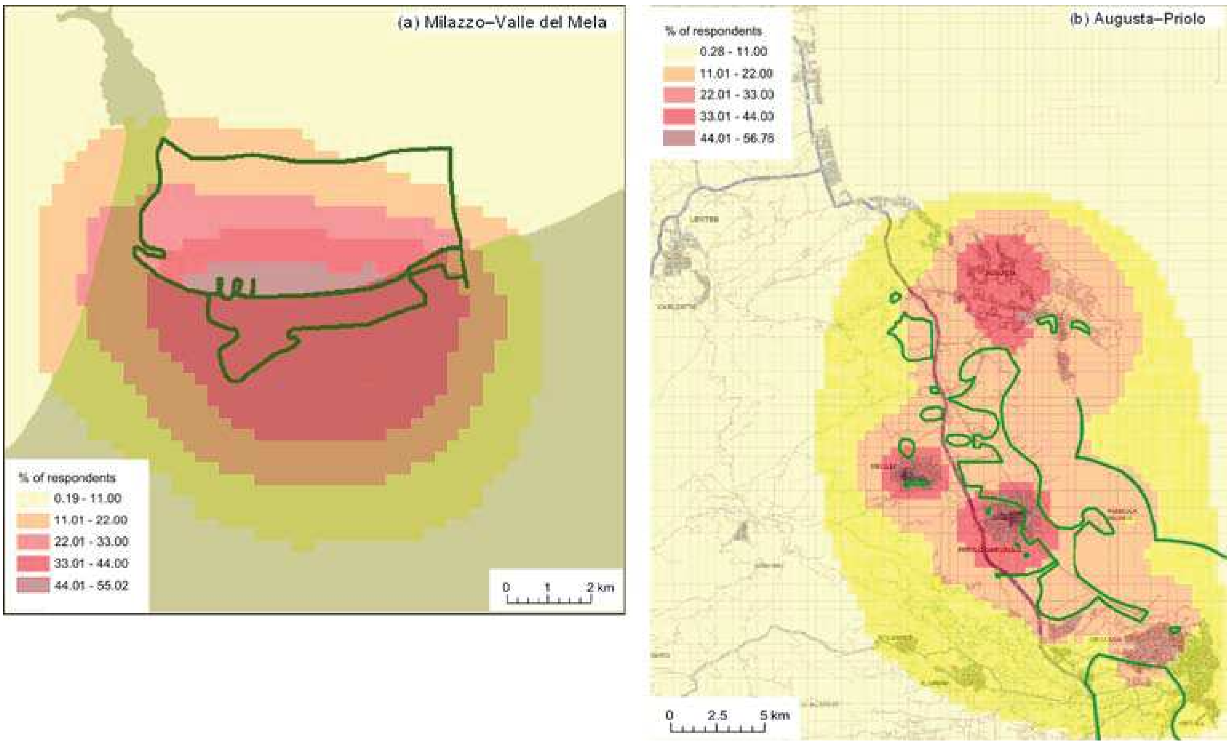
To survey the spatial cognitive representation of risk in the two areas, the mental map method (described earlier in this chapter) was used for each sample (Milazzo–Valle del Mela and Augusta–Priolo). Considering that some sociodemographic variables – such as age (Pelling, 2003; Beck et al., 2010), gender (Fordham, 2000), education (Buckle, 2000; Beck et al., 2010), and being or not being employed or having children – were supposed to influence risk perception (see preceding sections in this chapter), we processed the mental maps of subsamples after distinguishing Milazzo–Valle del Mela and Augusta–Priolo respondents by age, gender and education.

The influence of age, gender and education

In both populations, at least one respondent considered the entire area represented on the map to be at risk. Very few survey respondents did not produce a mental map in the questionnaire: 5% in the Milazzo–Valle del Mela area and 8% in the Augusta–Priolo area. We cannot assume, however, that these people considered that the area in which they live was free of risks; we can only say that at least 95% of the respondents in the Milazzo–Valle del Mela area and at least 92% in the Augusta–Priolo area thought that in the territory in which they live some residential areas are exposed to a petrochemical hazard.

In the case of the Milazzo–Valle del Mela area, the overlap between the perceived and the official (real, in green) area at risk is quite good (Fig. 55a), even if the risk in the maritime area –located on the northern part of the map – is denied, as fewer surveyed people circled it on their mental map. This means an overall shift of the perceived risk, compared with the official mapped risk, and a darker red area on the map out of the green polygon that represents the official mapped boundaries (Fig. 55a). We assumed that the boundaries of the hazardous area are much more difficult to identify in the sea, which constitutes a rather specific environment. The cognitive representation of this territory can therefore differ from that of a continental territory. We also observed that risk perception is biased towards the south (the inhabited land).

Fig. 55. Synthetic map of perceived risk for the two areas



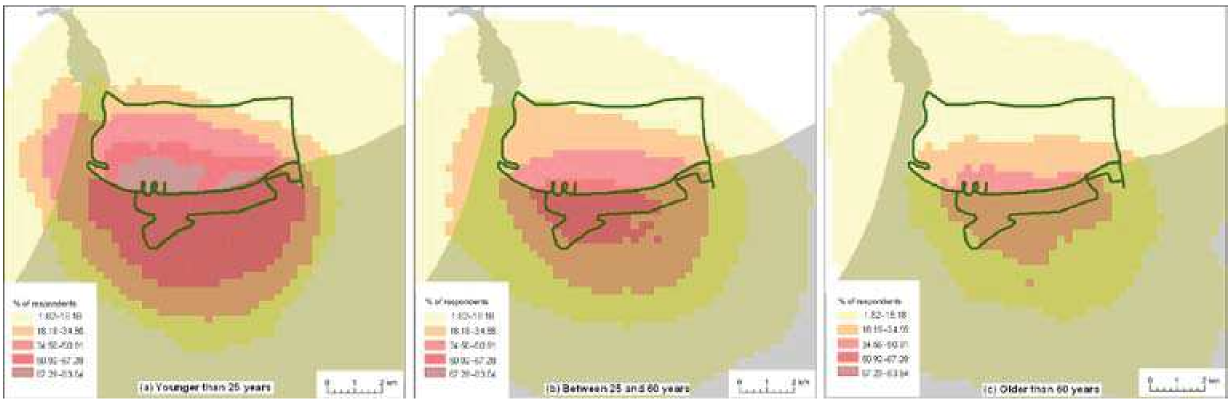
Note. The green lines correspond to the official boundaries of the sites of national concern.

Of the two areas, the boundaries of the official risk are much more complex in the case of Augusta–Priolo (Fig. 55b), because there are pockets of risk areas, instead of one well-defined area; therefore, the match between perceived and real risk is less obvious. The particular details of the Augusta–Priolo case lie in there being some areas without petrochemical danger that were considered as such, especially around the cities of Augusta, Melilli and Priolo Gargallo. This comes from the population knowing that some dangerous plants are located on the territory of these cities. However, the survey respondents do not know exactly where in the territory they are located; thus, many of them circled the name of the city or the spatial extent of its urban space on the map instead of the precise high-risk area. This reflects respondents often not being able to accurately identify the spatial extent of a risk, though they are conscious of it (Beck, 2006).

When trying to understand which social groups tend to overestimate or underestimate risk, we first focused on the influence of age. Three social groups were considered: young people (younger than 25 years), corresponding to students and young workers; workers (between 25 and 60 years of age); and, finally, elderly and retired people (older than 60 years of age). These three groups also allowed us to see whether being a student, worker or retiree influences perception.

Fig. 56 shows that, for older respondents, the area of perceived risk is smaller, while for the younger respondents a higher proportion of people circled the same area, and these people have a common perception of risk. The young people tend to overestimate risk (spatially speaking) more than the elderly, whereas the elderly seem to globally underestimate risk.

Fig. 56. Synthetic map of perceived risk by age groups in the Milazzo–Valle del Mela area



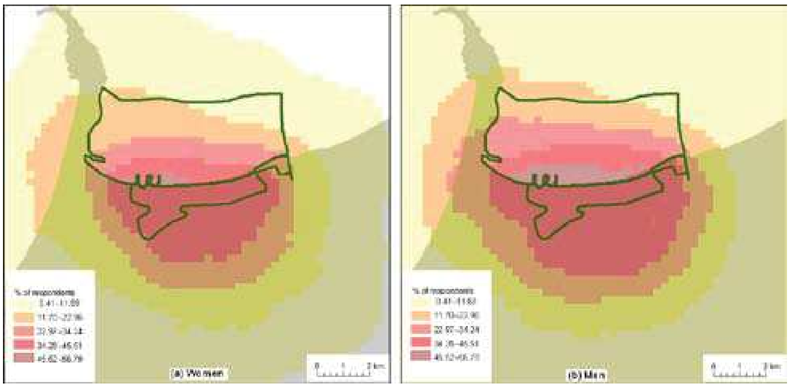
Note. The green lines correspond to the official boundaries of the sites of national concern.

We can assume that experiences of life, of places or of previous accidents (which can be, among other factors, related to age) help create a more precise idea of the spatial extent of risk. The higher proportion of young people having a common risk perception can be linked to the special context of their education.

In general, gender is one factor known to explain risk perception (Flynn, Slovic & Mertz, 1994). Usually, perception studies show that women tend to overestimate risk or, at least, to have a rather coherent perception of so-called real risk. In the case of Milazzo–Valle del Mela, however, more men tended to have circled a larger area – that is, a smaller dark red area (the area considered as risky was smaller in that case for women than it was for men). Thus, men tended to overestimate risk. As for the elderly (Fig. 56c), women were less numerous to have a common risk perception (Fig. 57a), compared with men. The opposite observation was made in Augusta, where women tended to overestimate the territorial extension of risk, compared with men.

Concerning the influence of education, very slight differences were observed between people with a higher level of education and those with no diplomas or a lower level of education.

Fig. 57. Synthetic map of perceived risk by gender in the Milazzo–Valle del Mela area



Note. The green lines correspond to the official boundaries of the sites of national concern.

Conclusions

The PRITASC survey applied and combined statistical methods and spatial analysis techniques to assess and compare risk perception in the two high-risk areas of Milazzo–Valle del Mela and Augusta–Priolo.

The research shows that, within the different risk perception patterns observed in the two areas, populations have identical risk perception profiles for health and environmental hazards. Also, their socioeconomic characteristics (such as gender, education, age, working conditions and the presence of children) influence risk perception.

The deep insights provided by the mental map show that local populations have a quite clear understanding of the spatial dimension of risk in their territories, especially in the Milazzo–Valle del Mela area, where the localization of the contaminated area is more similar to the official one than in the Augusta–Priolo area. In the latter area, the risk is more complex, which does not help people identify its spatial extent. In Milazzo–Valle del Mela, the maritime area is barely considered as hazardous, as it consists of a specific environment with imprecise boundaries.

The combination of statistical analysis of risk perception and cognitive spatial analysis in the PRITASC survey revealed a strong gender distinction for the perception of territorial risk (especially in the area of Milazzo–Valle del Mela). Also, the male population is in general less worried, but their territorial perception is wider – for example, it incorporates the whole remediation site – than the one offered by the women interviewed. Finally, health risk perception is influenced by gender, education, working conditions, and the presence of children.

In light of people's involvement in prevention strategies aimed at risk reduction and management and territorial remediation, the results of the PRITASC survey are of major importance to risk communication.